Australian spark arrester tests : test no. SPA-21 : Caterpillar D7 turbocharger

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FORMAL tests on spark arresters are conducted by The Tractor Testing Committee* at the Testing Station, Werribee, on behalf of those Companies concerned with tractors, engines or spark arresters who wish to have these equipments tested. The arrester is tested on the engine it is specially designed for (as in this instance), or if it is sold for use on any or several engines, it is tested on an engine of the highest power for which the spark arrester is intended.

1.—Test Procedure.

The method of test is based on a procedure standardised by the Society of Automotive Engineers (U.S.A.). This consists of feeding a weighed quantity of carbon particles of given size into the exhaust of the working engine, and then catching in a trap, and weighing, the particles that the arrester allows to pass through. Separate runs are conducted with particles of larger and smaller size; in some runs the engine is working at full load, in others at fast idle under no load.

* The Australian Tractor Testing Committee is a joint body established by agreement between the Commonwealth, the States, and the University of Melbourne; under this agreement the tests are carried out by the University of Melbourne. The address of the Tractor Testing Committee is: c/o Department of Primary Industry, 301 Flinders-lane, Melbourne.
According to the S.A.E. standard, no particles of the larger size should escape the arrester, and not more than 10 per cent. of the smaller size. At the same time the extra back pressure imposed on the exhaust system by the presence of the arrester should be no more than 10 inches in a water barometer.

2.—Identification.
Name: Caterpillar D7 Turbocharger.
Submitted by: Caterpillar of Australia Pty. Ltd.
For Particular Tractor: Caterpillar D7.

3.—Brief Specification of Arrester.
Operating Principle: Reduction of carbon particle sizes.
Declared Maximum Horse-Power: 140.
Mounting: Under engine cowling, ahead of operator, effluent upwards.
Details of Test Engine: Caterpillar type D339 4-cylinder diesel; 140 horse-power maximum; 831 cubic inches; rated speed, 1,200 r.p.m.

4.—Summary of Test Results.
(Particles injected at rate of 100 gms. in five minutes.)
(a) Effectiveness of Spark Arresting:

<table>
<thead>
<tr>
<th>Particle Size</th>
<th>Engine Load Condition</th>
<th>Carbon Passing Arrester (Per cent.)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>High</td>
<td>Nil</td>
<td>Two tests</td>
</tr>
<tr>
<td>Large</td>
<td>Low</td>
<td>Nil</td>
<td>Two tests</td>
</tr>
<tr>
<td>Small</td>
<td>High</td>
<td>0-6</td>
<td>One test only</td>
</tr>
<tr>
<td>Small</td>
<td>Low</td>
<td>Nil</td>
<td>Two tests</td>
</tr>
</tbody>
</table>

(b) Back Pressure: Not relevant, since the Turbocharger is integral with the engine, and since no other spark arresting device was added.

(c) Temperatures: Ambient air—75° F. Body of Turbine—680° F. approximately.
(d) Noise Levels: Not taken.

5.—Comment.
(a) Most of the sample weight injected passed out as dust through the 28-mesh gauze outlet of the test trap. Between 20 per cent. and 40 per cent. was recovered in the form of particles finer than the “small” (25 mesh) size.

(b) The low load tests were carried out with no load at 700 to 800 engine r.p.m. A series of trials at lower speeds showed that some particles would pass through the turbine at no load speeds below about 650 engine r.p.m. Results of these tests (one run in each case) with “large” carbon are as follows:

<table>
<thead>
<tr>
<th>Engine r.p.m.</th>
<th>465</th>
<th>520</th>
<th>600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of large carbon passing—</td>
<td>3-5</td>
<td>2-5</td>
<td>1-0</td>
</tr>
</tbody>
</table>

Further brief tests at these speeds with some load indicated that the proportion of large carbon passing the turbocharger decreases as the load increases.

The above table is extended as follows:

<table>
<thead>
<tr>
<th>Engine r.p.m.</th>
<th>465</th>
<th>520</th>
<th>600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of large carbon passing—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>at No Load</td>
<td>3-5</td>
<td>2-5</td>
<td>1-0</td>
</tr>
<tr>
<td>at 6½ h.p.</td>
<td>2-0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>at 16 h.p.</td>
<td>1-0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>at 21 h.p.</td>
<td></td>
<td>0-6</td>
<td></td>
</tr>
</tbody>
</table>

The tractor tested was bare of equipment; in any practical situation the cable control and other gear would impose a certain minimum load at any speed.

W. F. BAIIIE.
Testing Officer.
G. H. VASEY.
Officer In Charge
Tractor Testing.
University of Melbourne, 11th September, 1959.